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ITALIAN INDIGO MISSILE FOR ANTIAIRCRAFT DEFENSE AT LOW ALTITUDE--ETC(U)
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(INDIGO, Missile Italiano per la Difesa C.A. A Bassa Quota a Terra e a Bordo)

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ITALIAN INDIGO MISSILE FOR ANTIAIRCRAFT DEFENSE AT LOW ALTITUDE -- ON LAND AND AT SEA

[INDIGO, Missile Italiano per la Difesa C. A. A Bassa Quota a Terra e a Bordo; Rivista Marittima, February 1976, pp. 128-132; Italian]

In the conflict between missile and aircraft, which calls to mind /128*
the old conflict between guns and armor, what assumes particular importance is counteraction at those low flight altitudes which offer attacking aircraft greater possibilities of evading search radar, besides allowing them to take advantage of the orographic characteristics of the combat zone in the best possible way.

It is the opinion of experts that the most advantageous altitudes are 50 to 300 m. In an attack using conventional explosives for mobile targets, a timely recognition of the target itself is necessary. That necessitates flying at an altitude of not less than 100 m and a speed of not more than Mach 0.8 (850 km/hr). The launch will then take place from a distance of 2-3 km. For fixed targets, the distance does not change, but the speed can be as great as Mach 1.2 (1,270 km/hr). Therefore, it is necessary for the defensive weapons systems to have very short reaction times and to be equipped with missiles having high performance capabilities. We will add that in the case of an attack using air-to-surface missiles or remote-controlled bombs with nuclear charges (such a case being outside the purview of this article), the launch could be made from a distance of about 15 km. Consequently, the defensive systems must have a broad acquisition range and weapons with a considerable range.

Several nations have ~~therefore~~ developed types of missiles suitable /130
for defense at low altitude. Among those is Italy, which has developed several interesting systems, the ALBATROS, which has already been adopted by the Navy, the INDIGO, which we will now describe, and the SPADA.

The development of the INDIGO was promoted by the Ministry of → CONT.

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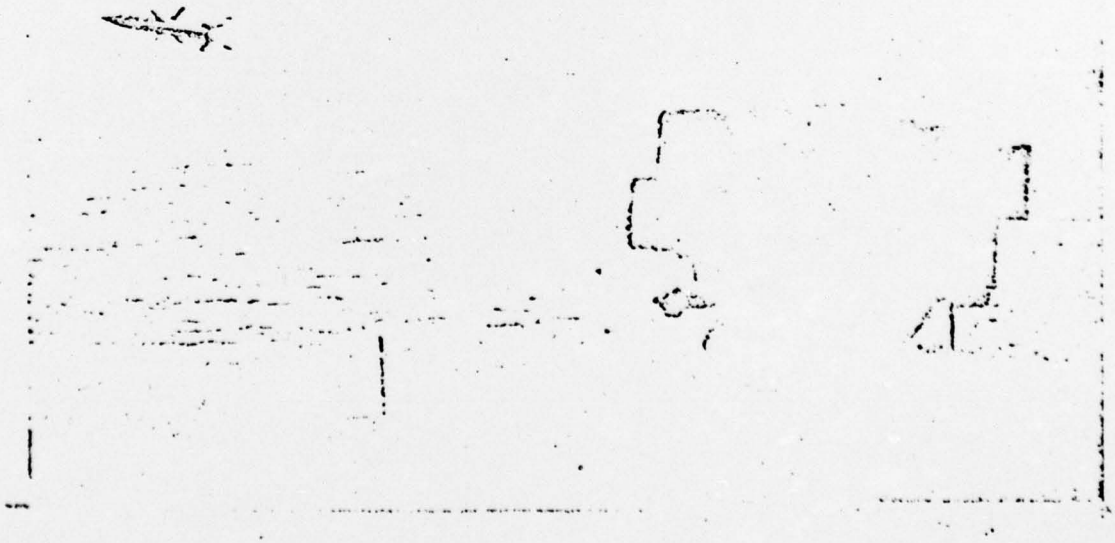
* Numbers in the right margin indicate pagination in the original text.

Defense in order to resolve, in accordance with the specifications established by NATO, the problem of close defense against low-altitude attacks. Studies on that subject were begun in 1962 by the Contraves Co. and continued until, in 1969, the entire program was undertaken by the Sistel Co. (formed with the participation of Contraves itself and other Italian companies), which studied three versions [of the missile launcher]: one towed on land, one shipborne, and a self-propelled land version. Currently, after an extensive and favorable series of tests made at the Sardinia proving grounds, the first version of the weapon (the towed land model) is fully operational.

The INDIGO has the following characteristics: length, 3,076 m; diameter, 195 mm; launch weight, 120 kg. It has an advanced aerodynamic configuration. The cruciform control wings have an 813-mm span. They are installed very near the center of gravity, which thus permits a rapid response to signals emitted by the guidance system. In line with those wings are the stabilizing tail fins.

The propulsion is ensured by a solid-propellant booster which produces a 3,750-kg thrust and burns for 2.5 seconds. At the end of combustion the missile reaches a speed of Mach 2.5 (2,650 km/hr) and its



Launching of the short-range surface-to-air INDIGO missile.

weight is reduced to 80 kg. The range is as much as 10 km and the operational height is between tree level and 5,000 m.

In case of possible evasive maneuvers by the target, the flying time can be a maximum of 30 seconds. If the missile fails to intercept the target after that interval, it self-destructs. The missile can withstand a longitudinal force of 40 g and a lateral force of 30 g.

The warhead weighs a total of 22 kg and is of the fragmentation type, symmetrical around the axis. It has an impact fuze and an infrared proximity fuze.

The circuits of the guidance system are run by batteries which are activated at launch time. The antennas of the radio receivers and an infrared transmitter are mounted on the four stabilizing tailfins. The antennas have great directivity and electronic disturbances which may be emitted by the target are therefore very much attenuated.

The guidance system may be operated in two ways:

1. "All-weather," using radio control on a radar director beam combined with an infrared device, which after the launch keeps the missile on the radar beam;

2. "Fair weather" (very useful if weather conditions permit its use and when the enemy uses strong ECM). The infrared device, as in the first mode of operation, keeps the missile within the sighting field, and then, using a narrower beam, computes the movement of the missile with respect to the line of sight of the optical instrument which functions jointly with the infrared device. The missile has flares which facilitate the operation.

The launcher, which was designed to be easily transported by aircraft, helicopters, and motor vehicles, is made up of a complex of six tubes, which also serve as ramps. It can be deployed on any terrain which does not have a slope of more than 7°, and it is capable of making rapid movements in elevation and azimuth, with enough of a range to cover the entire space above. However, in the shipborne version, called SEA INDIGO (which, for now, is only in the research stage), the launcher is quadruple and is always easily reloadable.

The entire system has been produced using a very flexible modular technique which gives it great adaptability, simplicity, and ease of maintenance. The need for qualified personnel to operate it has also been kept within very reasonable limits. /131

On land the use of the INDIGO is being integrated with that of other longer-range missile systems, such as the U. S. HAWK. The HAWK missile weighs 580 kg and has a range of 35 km, thereby making it capable, for

(foto *SISTEL*)

Towable sextuple launcher for surface-to-air INDIGO missile, capable of rapid movements in elevation and azimuth.

example, of counteracting those aircraft which launch [missiles] from long distances away. The INDIGO is being integrated even more closely with very short-range defense artillery. In particular, with the addition of some modifications, the LPD-20 acquisition radar and the SUPER-FLEDERMAUS fire control system can monitor either INDIGO missiles or 35- or 40-mm antiaircraft machine guns. Thus, integrated missile-artillery units can be formed when necessary.

INDIGO is therefore able to assure the defense of the most critical rear areas, either used alone (possibly with machine guns), or together with HAWK missiles (above all when the presence of natural obstacles impedes or limits the action of the latter weapons system, which is heavier and has a greater range). It likewise ensures the continued use of the types of conventional weapons intended for defense of units deployed in combat areas by extending their capabilities for action in depth.

The characteristics of the INDIGO can be said to be derived from the compromise necessary to combine the opportunity to exploit the entire radar horizon normally available, which is about 15 km, with the need for having a missile that is not too expensive, can be installed on a multiple launcher, and is easily loaded. That is a necessity which, on the other hand, brings about the designing of relatively light missiles

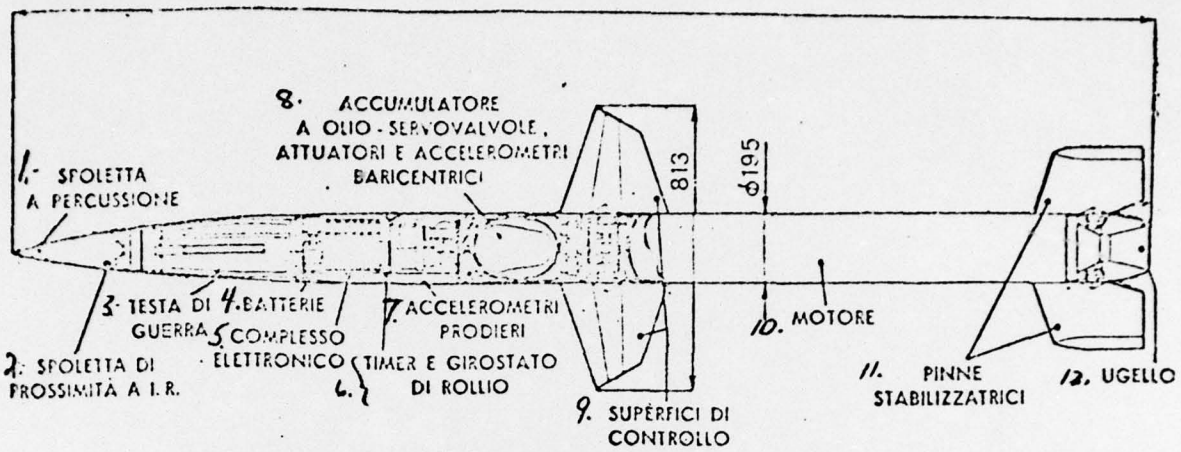


Diagram of the antiaircraft INDIGO missile used for low-altitude defense. /129
Italian industry has developed a towed, land-based, surface-to-air version (already operational) and a land-based, surface-to-air, self-propelled version (next to be put into service), and has studied a sea-based, surface-to-air version.

KEY

1. Percussion [Impact] fuze	8. Oil accumulator, servovalves, actuators, and barycentric accelerometers
2. Infrared proximity fuze	9. Control surfaces
3. Warhead	10. Engine
4. Batteries	11. Stabilizing tail fins
5. Electronic complex	12. Nozzle
6. Timer and roll gyrostat	
7. Forward accelerometers	

which therefore have relatively reduced performance capabilities.

The INDIGO can be launched singly or in salvo. The selection of weapons to be launched is either made automatically, by using a computer, or manually. The reaction times are very short, as that is quite /132
necessary for that type of short-range weapon. From the moment when the search radar gives the alarm, the fire controller can begin the sequence of fire within an interval which, according to attack conditions, can vary from 4 to 6 seconds. After another 2 seconds, the missile goes into ballistic flight [the booster phase]. Two seconds later the guidance phase begins. If firing in salvo, after half a second more, the engine of the second missile is ignited since the propulsion phase of the first missile to be launched is completed.

The self-propelled version, to be put into service next, has acquisition and tracking radar (being defined for production) and a fire control system (made by the Galileo workshops), both transported by

another self-propelled vehicle.

On the shipborne version, however, the quadruple ramp is connected with the SEA HUNTER fire control system, the same one which is used for the SEA KILLER Mk1 and Mk2 missiles.